

TECHNICAL SERVICE BULLETIN

TSB-MFT-0027

SUBJECT:	Repairs Best Practices - R404A and R134a Freezers and Refrigerators	Effective Date: March 5, 2018
MODELS:	07-CSG, 09/10/12/13-USG, 11/11M-CSGF, 12/20-USG, 15-UDG, 19/22-USG, 43/44-UDG	Revision: 04



The troubleshooting procedures described in this guide involve checking electrical live parts and/or working with live wires. Repairs must be performed by carried out by trained service personnel only.

A. Compressor Failure Diagnosis and Replacement

Compressors typically fail because something in the refrigeration system changes externally, which adversely affects the compressor performance. The most common root causes of compressor failures are: dirty or blocked condenser, condenser motor failure, evaporator motor failure, power supply out of range, refrigerant leak, faulty compressor electricals (capacitors, relays, and overload protector), incorrect installation, etc.

List of items to check for compressor diagnosis:

1. Thoroughly check all potential external root causes for compressor failures. If any of those causes are found in the system or installation, repair and correct them first and then proceed with compressor diagnosis as follows.
2. Check compressor amperage and compare to the relevant amps in Table 1. The measured stable current draw should be about 60% to 85% of the listed RLA amp.
3. Check compressor winding resistance and compare to the relevant resistances in Table 1. If windings are open, the compressor needs replacement.
4. Check continuity between compressor terminal pins and ground. If windings are shorted to ground, the compressor needs replacement.
5. Check capacitors capacitances (microfarad). Start capacitors have bleed resistors and they need to be temporarily removed for checking capacitances. If capacitors are out of specs, replace faulty capacitors.
6. Check compressors external relay and/or overload protector for continuity and if found defective, replace them.
7. If the compressor trips the overload protector repeatedly and capacitors are within the specs, the compressor piston may be locked (stalled). The compressor must be replaced.
8. If the compressor runs on excessive low-side pressure, above 25 PSIG for freezers and 40 PSIG for refrigerators, with all other elements functioning properly (clean condenser, condenser fans running, etc), the compressor needs replacement.
Note: If the cabinet is warm or has just been turned on, please allow approx. 15-30 minutes prior to checking pressures.
9. If the compressor produces noticeable loud internal noise, replace the compressor.

Table 1: Relevant data for compressor diagnosis

Freezer Model	Compressor Model	Volts	Current		Winding Resistance (ohms) at 77°C (25 °C)		Capacitors (microFarad)	
			RLA	LRA	C-S	C-R	Start	Run
07-CSGF,09/10/12-USGF, 11M-CSGF	NEK2134GK	115	5.6	38	7.32	1.10	189-227	N/A
11-CSGF, 13-USGF, 15-UDGF	NEK2150GK	115	7.8	42	4.50	0.77	189-227	N/A
19/20/22-USGF	NT2178GK	115	8.8	72	4.15	0.60	145-174	25
43/44-UDGF	NT2212GKV	208-230	8.0	46	6.00	1.20	88-108	20

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Refrigerator Model	Compressor Model	Volts	Current		Winding Resistance (ohms) at 77°F (25 °C)		Capacitors (microFarad)	
			RLA	LRA	C-S	C-R	Start	Run
07-CSGR,09/10/12-USGR	EM45HHR	115	1.8	17	12.95	4.8	145-180	N/A
13-USGR, 15-UDGR	EM65HHC	115	2.7	15	3.7	3.2	N/A	20
19/22-USGR	FFU100HAK	115	4.1	32.5	7.2	1.9	223-280	N/A
43/44-UDGR	FFU130HAK	115	3.4	40.3	3.75	1.1	378-454	N/A

Steps to replace compressor:

It is essential to establish the type of compressor failure that has occurred and whether a compressor burnout has occurred. If the compressor failure resulted from some form of an electrical failure, the compressor has undergone a burnout condition of some degree of magnitude. It is essential to determine the type and extent of the burnout before the new compressor is installed. If there was a mechanical failure that would cause a no pump condition (any situation where the motor starts and runs okay but little or no refrigerant is pumped), the system cleanup procedure can be bypassed.

1. Install access valves, such as bullet valves, on the low-side and high side process ports and recover refrigerant.
2. De-braze and remove compressor and filter/drier. With each compressor replacement, filter/drier must also be replaced.
3. Cut 1/2" inch off the capillary tube at the filter drier to ensure the capillary tube entrance is clean.
4. Clean the freezer refrigerant lines by blowing nitrogen through. Check whether excessive oil and sludge comes out of the lines. Excessive oil can be an indication of restrictions in the system (improper joint, excessive braze) and the restrictions must be removed before the new compressor is installed.
5. If a burnout is suspected, inspect the system by checking the compressor oil and refrigerant for acidity. If burn-out is found, follow a cleanup procedure after the compressor is replaced to clean the contaminated system of any remaining acid, sludge, and moisture. Several changes of liquid and suction line filter/driers may be required depending on the burnout severity.
6. Install and braze new compressor and filter/drier. To minimize oxidation and oxide dirt formations, a small flow of nitrogen must be maintained through refrigeration lines when brazing.
7. Connect refrigeration hoses and vacuum the unit from both high and low sides to less than 500 microns (micrometer Hg). To minimize refrigerant loss in hoses when charging, use as short of a hose as possible (not longer than 1.5 ft on the low side).
8. Disconnect the hose from the high side once vacuuming is almost complete; leave only the low side hose on the unit.
9. Charge the system with the specified refrigerant quantity and type using a weight scale through the low side port. The quantity and type of refrigerant are listed on the unit nameplate located inside the unit on the left wall.

Notes:

- The refrigerant charge is critical on these units and a weight scale must be used. Otherwise, unit performance may be adversely affected. It is not acceptable to charge "by pressures".
 - Since R404A refrigerant is a three-component mixture, it must be charged in liquid form to ensure the proper components mixture.
10. Start the unit. Monitor the temperature pull-down on the electronic controller and watch the pressure on the low side. Freezers should pull down to 0°F in about 1hr when located in an ambient of about 75 °F. When the temperature inside the freezer is at about 0°F, the low side pressure should be 8-10PSIG for R404A charged units.

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Refrigerators should pull down to 35°F in about 20 minutes when located in an ambient of about 75 °F. When the temperature inside the refrigerator is at about 35°F, the low side pressure should be 16-20PSIG for R134a charged units.

11. On units where burnout clean-up is required, change suction and liquid line filter/driers until the system is clean.
12. When unit performance is found acceptable, turn off the unit and wait for 5 minutes for pressures to equalize. Braze the last open ports and remove service valves from the unit.

B. Controller Diagnosis and Replacement

First, locate the controller model number printed on the controller faceplate just above or below the temperature display. It should be one of these three models:

TLY25

At the bottom of the controller display are the following LED indicators:

- 1. Indicates compressor status:
Light on - Compressor cooling on
Light off - Compressor cooling off
Light flashing - Start-up delay in progress
- 2. Indicates defrost status:
Light on - Defrost in progress
Light flashing - Freezer in dripping mode
- 3. Indicates fan status:
Light on - Cabinet fan ON
Light off - Cabinet fan OFF
Light flashing - Start-up delay in progress after defrost

TLY29

At the bottom of the controller display are the following LED indicators:

- 1. Indicates compressor status:
Light on - Compressor cooling on
Light off - Compressor cooling off
Light flashing - Start-up delay in progress
- 2. Indicates defrost status:
Light on - Defrost in progress
Light flashing - Freezer in dripping mode
- 3. Indicates fan status:
Light on - Cabinet fan ON
Light off - Cabinet fan OFF
Light flashing - Start-up delay in progress after defrost

X34

At the left side of the controller display are the following LED indicators:

- 1. Indicates compressor status:
Light on - Compressor cooling on
Light off - Compressor cooling off
Light flashing - Start-up delay in progress
- 2. Indicates defrost status:
Light on - Defrost in progress
Light flashing - Refrigerator in dripping mode
- 3. Indicates fan status:
Light on - Cabinet fan ON
Light off - Cabinet fan OFF
Light flashing - Start-up delay in progress after defrost.
- 4. Indicates internal clock is running.
Flashing slowly - clock error (i.e. clock chip not working).
Flashing rapidly - the clock battery is drained.
- 5. Indicates the alarm status:
Light on - Alarm is on
Light off - Alarm is off
Light flashing - Alarm silenced or memorized

Some controller failures/malfunctions may include the following behaviours:

1. Controller displays EEP or EPr or Err.
Action: This message means the controller has an internal failure and must be replaced.
2. Controller displays “E1” on TLY25, or “Pr1 diSC” on TLY29 and X34
Action: This message means that probe 1 (cabinet probe) is open (disconnected, or broken, or damaged).
 - Check the probe connections at the controller
 - Check the probe resistance when disconnected from controller. The resistance should be 10kOhm at 77 °F
 - Check the probe along its length for damage, piercing, etc.,
If needed, replace the probe, or fix and insulate the broken spot.
3. Controller displays “-E1” on TLY25, or “Pr1 Short CC” on TLY29 or X34
Action: This message means that probe 1 (cabinet probe) is short-circuited.
 - a. Check the probe connections at the controller
 - b. Check the probe resistance when disconnected from controller. The resistance should be 10kOhm at 77 °F
 - c. Check the probe along its length for damage, piercing, etc.
If needed, replace the probe, or fix and insulate the broken spot.

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4. Controller displays “E2” on TLY25, or “Pr2 diSC” on TLY29 or X34
Action: In this case probe 2 (evaporator/defrost probe) is open. Use the same troubleshooting steps as described for probe 1 in section 2.
 5. Controller displays “-E2” on TLY25, or “Pr2 Short CC” on TLY29 or X34
Action: In this case probe 2 (evaporator/defrost probe) is short-circuited. Use the same troubleshooting steps as described for probe 1 in section 3.
 6. Controller displays “HI” on TLY25, or “HI °F” or “HI °C” on TLY29 or X34
Action: This message means the temperature inside the cabinet is too high. First, check other potential external causes: refrigerant leak, dirty/blocked condenser, power supply, extension cord use, ice build-up on evaporator, excessive door openings, cabinet installation and environment, compressor faults, condenser or evaporator fan faults.
If all external potential causes are okay, then the controller and/or probes may be malfunctioning.
 - Use a separate thermometer and place your thermometer’s probe on the tip of the cabinet probe, close the cabinet door, and wait for two to three minutes for temperature to stabilize. Compare the two readings. The deviations should not be more than $\pm 5^{\circ}\text{F}$. If you see larger deviations in temperature readings, completely disconnect probe 1 from the controller, the TLY25 should flash “E1”, TLY29 or X34 should flash “Pr1 diSC”. If you do not see these signals flashing and the controller displays temperature readings instead, the controller must be replaced.
 - Check the probe along its length for damage, piercing, etc.
 - Check the probe resistance when disconnected from the controller. The resistance should be 10kOhm at 77 °F
 - If needed check probe 2 (evaporator/defrost probe) using the same procedure as above. To get probe 2 reading on the display, press and release U button. The controller will flash Pr2 followed by its actual temperature reading. When probe 2 is disconnected from the controller, TLY25 should flash “E2”, TLY29 or X34 should flash “Pr2 diSC”.
- Notes:
- With controller cabinet probe (Pr 1) reading failure, the most common symptoms are:
- Cabinet probe reading outside the typical expected range, usually around 170F
 - Products inside freezer are satisfactory, or even too cold, but the controller displays too warm temperature. The buzzer may be going off too.
 - Products are warm or melting
- With controller evaporator probe (Pr 2) reading failure, the most common symptoms are:
- Evaporator probe reading outside expected range, usually around 170F
 - Controller displays temperature around 20 °F to 45 °F with evaporator fans off
 - Products is warm or melting
 - Ice/frost build up on evaporator
7. Controller displays “Lo” on TLY25, or “Lo °F” or “Lo °C” on TLY29 or X34
Action: This message means the temperature of the evaporator coil is too low. First, check other potential external causes: cabinet set point too low, compressor relays stuck in closed position, and ice buildup on the evaporator. If all external potential causes are okay, then the controller and/or probes may be malfunctioning.
 - Use a separate thermometer and place your thermometer’s probe on the tip of the cabinet probe, close the cabinet door, and wait two to three minutes for the temperature to stabilize. Compare the two readings. The deviations should not be more than $\pm 5^{\circ}\text{F}$.
 - If you see larger deviations in temperature readings, completely disconnect probe 1 from the controller, the TLY25 should flash “E1”, TLY29 or X34 should flash “Pr1 diSC”. If you do not see these signals flashing and the controller displays temperature readings instead, the controller must be replaced.
 - Check the probe along its length for damage, piercing, etc.
 - Check the probe resistance when disconnected from the controller. The resistance should be 10kOhm at 77 °F

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- If needed check probe 2 (evaporator/defrost probe) using the same procedure as above. To get probe 2 reading on the display, press and release U button. The controller will flash Pr2 followed by its actual temperature reading. When probe 2 is disconnected from the controller, TLY25 should flash “E2”, TLY29 or X34 should flash “Pr2 diSC”.
8. Compressor runs continuously even though the freezer temperature is below the set temperature.
Action: Check the cooling/compressor relay on the controller and the external compressor relay/contact. The relay(s) may be stuck in the closed position. The controller cooling relay can be checked by placing voltmeter probes on terminals 7 and 2 on TLY25, terminals 7 and 4 on TLY29, terminals 18 and 28 on X34. The voltmeter should read about 115V when the controller calls for the compressor to run, and 0V when the controller shuts off the compressor. When the compressor is in ON mode, the symbol “Out” on TLY25, “Comp” on TLY29, and X34 is lit up. If the controller does not call for cooling and its cooling relay is stuck in closed position, replace the controller. If the compressor external relay is stuck in closed position, then replace the relay.
 9. Compressor never turns ON even though the freezer temperature is high.
Action:
 - Check the compressor wiring
 - Check the compressor relay on the controller and the external compressor relay/contact. The relay(s) may be stuck in open position. The controller compressor relay can be checked by placing voltmeter probes on terminals 7 and 2 on TLY25, terminals 7 and 4 on TLY29, terminals 18 and 28 on X34. The voltmeter should read about 115V when the controller calls for compressor to run, and 0V when the controller shuts off the compressor. When the compressor is in ON mode, the symbol “Out” on TLY25, “Comp” on TLY29 and X34, is lit up. If the controller calls for cooling and the cooling relay is stuck in open position, replace the controller. If the compressor external relay is stuck in open position, then replace the relay.
 10. Defrost heater turned on continuously
Action: Check the defrost relay on the controller (and an external defrost relay on 43/44-UDGF models), the relay(s) may be stuck in the closed position. The controller defrost relay can be checked by placing voltmeter probes on terminals 7 and 3 on TLY25, terminals 7 and 2 on TLY29, and on terminals 21 and 28 on X34. The voltmeter should read about 115V when the controller calls for defrost, and 0V when the controller shuts off defrost. When the freezer is in defrost mode, the symbol “Def” is lit up. If the controller does not call for defrost and the defrost relay is stuck in closed position, replace the controller.
 11. The freezer never goes into defrost or defrost does not appear to be functioning correctly.
Action:
 - Check the defrost heater wiring for broken or damaged wire, disconnected wire,...
 - Run a manual defrost by pressing and holding the defrost button (arrow UP button) on the controller for about 10 seconds. The compressor and evaporator fan(s) should stop, defrost heater should be energized, and the defrost symbol on the controller is lit.
 - Check the defrost relay on the controller (and an external relay on 43/44UDG model), the relay(s) may be stuck in open position. The controller defrost relay can be checked by placing voltmeter probes on terminals 7 and 3 on TLY25, terminals 7 and 2 on TLY29, terminals 21 and 28 on X34. The voltmeter should read about 115V when the controller calls for defrost, and 0V when the controller shuts off defrost. When freezer is in defrost mode, the symbol “Def” is lit up. If the controller calls for defrost and the defrost relay is stuck in the open position, replace the controller.
 12. Controller displays “AP” or “AL” on TLY25, or “door oPEn” on TLY29 and X34
“AP” or “AL” or “door oPEn” messages indicate door open status.
Action:

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- Make sure the door closes properly. Ensure the metal bracket, mounted on the door frame, presses the door switch down.
- If door is closed, and one of the messages listed above is active, then the door switch or controller may be faulty. Disconnect the door switch blue wires from the controller and check for continuity through the switch with an ohmmeter. With the door button pressed in (door closed), there should be no continuity (open circuit). Replace the door switch if needed. If the door switch is okay, then replace the controller.

13. Controller displays “HAC” on X34

Action: “HAC” message means controller has recorded an alarm (high temperature or power loss). If you need to review the time of occurrence and duration, refer to the owner’s manual. To clear this alarm, press and hold the arrow down button on the controller for 5 seconds until the message clears.

C. Defrost Diagnosis and Replacement

Excessive ice/frost build up adversely affects freezer performance. It restricts the air flow through the evaporator and reduces cooling performance. Inspect the evaporator coil through evaporator fan openings. If the front of the coil is covered with ice/frost, the freezer may have a defrost problem.

Follow these steps to troubleshoot:

1. Check the freezer power supply. The voltage should be within $\pm 10\%$ of the nominal voltage. Make sure an extension cord is not used.
2. Run a manual defrost by pressing and holding the defrost button (arrow UP button) on the controller for about 10 seconds. The compressor and evaporator fans should stop, defrost and drain tube heaters should energize, and the defrost symbol “Def” on the controller should be lit.
Note: The drain tube heater runs in defrost mode only - it is not running continuously like on some other OEM’s freezers on the market.
3. Remove the narrow cover at the back of the freezer and place an amp meter around the grey (defrost) wire. The grey wire feeds the power to the heaters.
4. Compare the measured current reading to the relevant amps in table 2 and allow $\pm 10\%$ variations for manufacturing tolerances, voltage variations, and measuring inaccuracies.
5. If the amp meter reads zero (current is not present), then:
 - Check wiring from the controller to the heaters for open circuit (broken or damaged wire, disconnected wire,...)
 - Disconnect defrost heaters and check resistances and compare to the relevant data in table 2.
 - Check the defrost relay on the controller, and external defrost relay on 43/44-UDGF models. The controller defrost relay can be checked by placing voltmeter probes on terminals 7 and 3 on TLY25, terminals 7 and 2 on TLY29, terminals 21 and 28 on X34. The voltmeter should read about 115V when the controller calls for defrost, and 0V when the controller shuts off defrost. When freezer is in defrost mode, the symbol “Def” is lit on the controller display. If the controller calls for defrost and the defrost relay is stuck in the open position, replace the controller.
6. In a case when ice accumulates on the back inner wall and runs all the way down to the freezer bottom, check the drain heater for resistance. If the drain heater resistance is out of specs, replace the drain heater. If in the drain heater is in good condition, please contact Minus Forty for the repair kit.
7. Once the defrost malfunction cause is found and repaired, the evaporator and drain tubes must be completely free of ice and clean. If excessive ice is left on the evaporator and/or in drain tube, the defrost system will not be able to clear this excessive ice accumulation.

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Table 2: Relevant data for defrost and drain tube heaters diagnosis

Freezer Model	Heater Function	Volts	Current(amps)	Resistance (ohms) at 77°F(25 °C)
07-CSGF	Defrost	120	5.0	24
09/10/13-USGF	Defrost	120	3.7	32
11/11M-CSGF	Defrost	120	4.8	24.8
12-USGF	Defrost	120	3.3	36.0
15-UDGF	Defrost	120	5.8	20.6
19/20/22-USGF	Defrost	120	4.8	25
All above models	Drain Tube	120	0.16	720
43/44-UDGF	Defrost	208-240	4.2 @ 208V	49
			4.8 @ 240V	
43/44-UDGF	Drain Tube	208-240	0.09 @ 208V	2116
			0.11 @ 240V	

D. Evaporator Fan(s) Diagnosis

The evaporator fan(s) control and operation is briefly summarized as follows:

Freezers: The evaporator fan(s) are controlled by the evaporator/defrost probe, the door switch, and the controller. The fan(s) stops when the door is open. When the evaporator probe temperature is at or above 25 °F, the controller shuts off the evaporator fan(s). When the evaporator probe temperature is below 20 °F, the evaporator fan(s) are running continuously.

Refrigerators: The evaporator fans are controlled by the door switch and the controller, and run continuously except when the door(s) is open. The evaporator/defrost probe has no impact on the evaporator fan operation. Some refrigerator models in specialty pharmaceutical applications have the evaporator fan(s) programmed to be off during compressor off time.

Freezers and Refrigerators: When the controller calls for fans to run, the “Fan” symbol is lit on the controller display. To obtain evaporator probe reading, press and release U on the controller, then “Pr2” will be flashing followed by the evaporator probe actual temperature.

The procedure below describes the troubleshooting process for freezers and can also be applied to refrigerators with the exception of the noted evaporator probe impact. There are three distinct temperature ranges of the evaporator probe readings that impact the evaporator fan status in freezer models:

1. The evaporator probe temperature is at or above 25 °F. The controller shuts off the fan(s).
2. The evaporator probe temperature is below 20 °F. The fan(s) runs continuously.
3. The evaporator probe temperature is in the range 20 °F to 25 °F. The evaporator fan(s) can be either on or off.

If the freezer has been unplugged for some time, plug in the freezer and allow at least 30 minutes for evaporator probe to reach temperatures around or below 20 °F. Ensure the compressor is running and follow troubleshooting guides as follows to identify the cause for fan(s) malfunctioning:

1. Evaporator probe temperature is below 20°F, but the fan(s) are not running

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Both freezers and refrigerators:

- Check the “Fan” symbol on the controller display - it should be lit at this time. If the symbol is not lit, replace the controller.
 - Check whether the door is closed and the door switch button is pushed in by the door bracket. When door opens, fans are stopped.
 - Check wiring from the controller to the fans.
 - Check voltage at fans wiring ends. It should read about 115V when controller calls for fans and the door is closed.
 - Check the fan relay on the controller. The relay may be stuck in open position. The controller fan relay can be checked by placing voltmeter probes on terminals 7 and 4 on TLY25, terminals 7 and 5 on TLY29, terminals 23 and 28 on X34. The voltmeter should read about 115V when the controller calls for fans to run, and 0V when the controller shuts off fan(s). When fan(s) is on, the symbol “Fan” is lit up. If the controller calls for fans and the fan relay is stuck in the open position, replace the controller.
 - If 115V is present at fan(s) terminals but the fan(s) do not run, then check the fan(s) and replace if found faulty.
2. Evaporator probe temperature above 25°F
- Check the “Fan” symbol on the controller display.
Freezers: it should not be lit at this time and the fans should not be running. Otherwise, replace the controller.
Refrigerators: it should be lit at this time and the fans should be running. Otherwise, replace the controller
3. Evaporator probe fluctuating in the range 20°F to 25°F
- Refrigerators: The “Fan” symbol should be lit at this time and the fans should be running. If not running, replace the controller.
 - Freezers: Wait until the evaporator temperature stabilizes either below 20°F or above 25°F, and then proceed as per scenario 1 or 2 above. If the temperature does stabilize in one of those two regions (above 25°F or below 20°F), then look for other external malfunction causes such as: refrigerant leaks, door open, gasket leaks,...

E. Condenser Fan(s) Diagnosis

The condenser fan(s) are controlled by the controller and are wired in parallel with the compressor to run concurrently. Condenser fan(s) and compressor do not run during the 6-minute start-up delay when the controller is repowered (“StArt dELAY” message scrolled on the controller). If the controller calls for the compressor (“Comp” symbol lit on the controller) and the compressor runs but the condenser fan(s) does not run, then:

- Check the condenser fan wiring and voltage at the fan connection points. If you see about 115V and the fan does not run, then replace the fan
- If the fan blade appears to spin slowly, check the rpm (revolution per minute) by using a suitable tachometer. The fan blade should run between 1400 and 1600rpm. If not, replace the fan motor.

If both the compressor and the condenser fan(s) do not run when the controller calls for, then check the controller cooling relay and the compressor external relay (refer to Section C above).

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F. Door Heated Glass Diagnosis

Note: Door heated glass comes on freezers only. Refrigerators have non-heated glass.

Our door heated glass is designed to operate moisture/fog free in ambient conditions of up 80°F, 60% relative humidity. If you notice excessive moisture formations on the outer glass pane or between glass panes, follow these guidelines to troubleshoot the problems.

1. Condensation is forming between the glass panes inside the insulated glass unit.
 - This is irreparable and the door should be replaced.
2. The condensation is forming on the outer surface of the door.
 - Check whether ambient conditions exceed recommended 80°F, 60% relative humidity and if so, some level of condensation is normal at these conditions.
Note: An economizer may be installed as part of the ambient HVAC system. Economizers may bring in a humid outdoor air causing humidity spikes or continuous high humidity levels. This is to be considered when measuring ambient conditions.
If the ambient conditions are stable and below 80°F, 60% relative humidity, then proceed with the following steps.
 - Located two white wires coming out of the door hinge. Check for open circuit and damage.
 - Place an amp meter around one the two wires, measure amps and compare to the relevant data in table 3. The measured amp should be within $\pm 10\%$ of the relevant data in table 3.
 - Locate the transformer(s) mounted on freezer side(s) in the compressor compartment (applicable to older 13-USGF, 22-USGF, and 44-UFGF models only, newer door versions are designed for direct connection to 115V power supply). Check the voltage on the primary side (115VAC), and secondary side (16VAC) which is feeding power to the door glass. The measured voltages should be within $\pm 10\%$ of the nominal voltages.
 - Disconnect door white wires and measure resistance. The measured resistance should be within $\pm 10\%$ of the relevant resistance in table 3.

Table 3: Relevant data for door heated glass

Freezer Model	Resistance (ohms)	Current (amps)
07-CSGF	660	0.17
09/09M/09X-USGF	560	0.20
10/10X-USGF	490	0.23
11-CSGF	434	0.26
11M-CSGF	337	0.34
13-USGF (with door heat transformer)	7.8	2.1
13-USGF (direct 115V connection)	455	0.25
15-UDGF	773	0.15
19-USGF	337	0.34
22-USGF(with door heat transformer)	7.0	2.3
22-USGF (direct 115V connection)	303	0.38
43-UDGF	413	0.28
44-UDGF (with door heat transformer)	5.6	2.9
44-UDGF (direct 115V connection)	382	0.3

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G. Perimeter (Anti-sweat) Heater Diagnosis

Perimeter heater(s) are located around the cabinet door opening in a groove just behind the front face. Their purpose is to reduce and eliminate cabinet condensation formation (sweating) on freezers. If the condensation is observed on the cabinet around the external perimeter of the door gaskets, then:

- Check whether ambient conditions exceed recommended 80°F, 60% relative humidity and if so, some level of condensation is normal in these conditions.
Note: An economizer may be installed as part of the ambient HVAC system. Economizers may bring in a humid outdoor air causing humidity spikes or continuous high humidity levels. This is to be considered when measuring ambient conditions.
- If ambient conditions are stable and below 80°F, 60% relative humidity, then check the current and resistance of perimeter heater(s) as per table 4. If the resistance is out of spec by more than ±10%, replace the heater(s).

Table 4: Relevant data for perimeter heaters

Freezer Model	Resistance (ohms)	Current (amps) @120VAC
07-CSGF	354	0.34
09/09M/09X-USGF	307	0.39
10/10X-USGF	293	0.41
11-CSGF	281	0.43
11M-CSGF	360	0.33
13-USGF	281	0.43
15-UDGF	337	0.37
19-USGF	238	0.51
22-USGF	227	0.53
43-UDGF	246	0.49
44-UDGF	241	0.50

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H. LED Light or Light Ballast and Bulb Diagnosis and Replacement

H.1 Units Equipped with Fluorescent Lights (freezers manufactured before June 2010)

All three fluorescent light bulbs (two inside freezer and one at the front top) are powered by single ballast located inside the top front light assembly. The ballast receives 115V on the input side via the light switch mounted on the controller box at the freezer bottom right corner. On the output side, the ballast delivers currents at 42kHz frequency and up to 600V. Because of the high frequency, it is not possible to measure the ballast output voltage using a standard voltmeter, specialized equipment is required. Use these guidelines to troubleshoot light problems.

1. All three light bulbs are not working
 - Ensure the power and light switches are in ON position
 - Install at least one new working bulb to verify whether all bulbs are faulty. Verify and replace all three strips if needed.
 - Replace ballast if the new bulb still does not light up.
 - If the new ballast does not resolve the problem, check the voltage (115V) on the ballast input side, black and white wires. If 115V is not present, check the light switch and continuity through black and white wires. If the wires are broken inside the foamed box, this fault is not reparable.
 - Check continuity through wires that are feeding the power to inner lights. Check for short between those wires and cabinet metal parts. If a short is found try removing front screws holding the evaporator shroud. One of those screws may have pierced the faulty wire.
2. One or two light bulbs are not working, and at least one bulb works
 - Replace non-working bulbs with new bulbs.
 - If still not working, switch the ballast blue and white wires from the working bulb to a non-working and vice versa and observe what happens with the bulb's working pattern. If the non-working bulb does not work again, replace the ballast. If replacing the ballast does not help, check continuity through bulb wires and check for short between those wires and cabinet metal parts. If a short is found try removing front screws holding the evaporator shroud. One of those screws may have pierced the wire(s) inside foamed cabinet.

H.2 Units Equipped with LED Lights (freezers and refrigerators manufactured after June 2010)

All LED light strips are powered by the LED driver(s) located near electrical (controller) box in the refrigeration compartment or inside the electrical box. The LED driver(s) receives 115V on the input side via the light switch mounted on the controller box. On the output side the driver delivers 12VDC and up to 5Amp. Use these guidelines to troubleshoot light problems.

1. All light strips are not working
 - Ensure the power and light switches are in ON position
 - Install at least one new working LED strip to verify whether all strips are faulty. Verify and replace all three if needed.
 - Check the voltage (115V) on the LED driver input side, brown and blue wires. If 115V is not present, check the light switch and continuity through the light switch wires.
 - Check the voltage (12VDC) on the LED driver output side, red and black wires. If 12V is not present, replace LED driver.
 - Check continuity through wires that are feeding the 12VDC power to inner lights. Check for short(s) between those wires and cabinet metal parts.
2. One or two LED strips are not working, and at least one LED strip works
 - Replace non-working LED strip.
 - If still not working, check continuity through LED wires and check for short(s) between those wires and cabinet metal parts. The red and the black wires are polarity sensitive, therefore observe wiring polarity.

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I. Refrigerant Leak Detection

Our upright freezers have a static/standing pressure of around 95PSIG and refrigerators have around 80PSIG at 80°F ambient temperature. This can be useful information for determining whether a unit has a refrigerant leak. If the unit is unplugged for about 24hrs or longer and if the standing pressure on either low or high side is less than 80PSIG (freezers) or 60PSIG (refrigerators), it is highly likely the unit has a refrigerant leak.

I.1 Finding Leaks with Electronic Leak detector

Ensure that environment in which the unit is being tested is not full of fumes that can give false alarm to electronic leak detectors. A calm environment with low air drafts is best when using electronic leak detector.

- Visually inspect entire refrigeration system for signs of oil leakage, corrosion cracks, or other damage. Follow the system tubing and joints in a continuous path so no potential leaks are missed.
- Make sure there is enough refrigerant in the system (at least 80PSIG standing pressure) to generate enough pressure to detect leaks.
- Check all service access port fittings. Check seals in caps if present. Check all joints on copper tubing.
- Move detector probe at 1" per second within 1/4" of suspected leak area. Refrigerant is heavier than air so position probe below test point. Minimize air movement in area to make it easier to pinpoint the leak.
- Verify an apparent leak by blowing air into suspected leak to clean the area and see if the leak remains.
- To check for leaks on the system low side, ensure the freezer is OFF and allow at least 5 minutes so pressure can build up on the low side.
- To check for leaks on the system high side, turn the freezer ON and move probe over suspected leak areas.

I.2 Finding Leaks with Soap Test

Use soap test as the last resort to test for refrigerant leaks or pinpoint hard to find leaks. A soap solution can be used when an approximate leak area is known, such as areas where recent service repair had been done or an electronic leak detector had indicated a leak presence in a particular area of the sealed system. If the system does not contain sufficient pressure for leak detection, the refrigerant can be recovered from the system and the system re-pressurized with dry nitrogen to increase the pressure. This makes finding leaks more probable and less time-consuming. Follow these steps:

- Clean the area to be tested using a clean, dry cloth.
- Apply soap solution with spray or brush to the suspected leak joint.
- Watch for bubble formation. Leak presence on the system will cause the soap bubble to expand. Such occurrence will require brazing repair, and/or parts replacement.
- Wipe and dry the area after the soap test.

I.3 Finding Leaks with Pressure Decay Test

This method consists of pressurizing the system with a high pressure, dry nitrogen gas. Apply a pressure of about 150 PSIG for at least 24 hrs, and then identify whether or not the pressure drops/decays during that time. Nitrogen can also experience pressure changes when it is exposed to varying ambient temperatures, so beware of this influencing factor. Follow these steps:

- Pressurize the system with dry nitrogen to about 150PSIG, and record the following information: date, time, ambient temperature and pressure of the test start.
- Leave the unit with the nitrogen charge for at least 24 hours, then record new pressure and ambient temperature.
- If pressure drop is more than 3% within the same ambient temperature, then further leak detection tests are required to pinpoint the leak.
- If ambient temperature has dropped, allow more time for pressure drop stabilization. If ambient temperature has increased, the pressure should increase correspondingly.

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I.4 Indirect Signs of Escaped Refrigerant

- Compressor runs at a lower current draw than in normal operation (see the Table 1 above for compressors typical current draws).
- A little or no heat coming out of the compressor into the discharge line. The compressor discharge line would be at about the same temperature as the surrounding ambient air and would feel cool when touched by hand.
- Presence of compressor oil around leak spots.